Enhanced Driver Assistance System for Road Accident Prevention Using Soft Computing Techniques

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Introduction

. A traffic accident is defined as a collision involving one or more vehicles. It can also affect other "moving objects," such as a pedestrian or cyclist. Fixed objects, such as trees, walls, or parked vehicles, can also play a role. A road accident can be considered a road-vehicle driver's failure to do one or several actions necessary to complete a journey without damage or loss. The accident that occurred could result in many injuries or damage to the property. Road traffic accidents are the most crucial general health concern, resulting in numerous injuries and deaths worldwide. **Advanced driver-assistance systems** (**ADAS**) are groups of electronic technologies that assist drivers in driving and parking functions and so on. The system takes vital steps like warning the driver or corrective action to avoid an accident during a risky situation.ADAS is proven to reduce road fatalities by minimizing human error.

Problem Statement

Lane detection, traffic sign recognition, and drowsiness detection are critical components in ADAS applications. Objects must be detected and tracked efficiently for road accident prevention.

Main Objectives

- To design and develop an Enhanced Advanced Driver Assistance System that detects Lane, traffic signs and Driver drowsiness using Soft Computing Techniques.

Specific Objectives

- To create Lane Departure Warning System to see the lanes in the driving path and warn the driver in case of out-of-lane conditions,
- To automatically recognize the traffic signs along the road to alert the drivers using Traffic Sign Recognition System,
- To develop an efficient Driver Drowsiness Detection System using face recognition technique to prevent accidents caused by the drivers getting drowsy.

Literature Survey:

M Juanita Sarah Rachel1, S Kalaiselvi2, R Salini3" **Lane Detection using Neural Networks," International Research Journal of Engineering and Technology (IRJET), E-ISSN: 2395-0056, Volume: 07 Issue: 03 | Mar 2020** This study shows that the traditional methodology is not implemented in real-time situations as it does not work well in dynamic conditions. So the author had proposed a lane detection algorithm that uses Canny Edge Detection, Hough Transform for Detecting the Lane, and Fully Convolution Neural Network to train and classify the Lane. The space between them is coloured green to show the Lane.

The calculated right/left lane curvature and center-lane offset are also shown in the image's top-left. Experimental results show that the classification accuracy of the classification network model for each category is more significant than 97.5%. The detection accuracy of the model trained by the proposed detection loss function can reach 82.24% in 29 different road scenes.

Suvarna Shirke 1, R. Udayakumar2" **Robust Lane Identification By Using EW-CSA Based DCNN**," Journal of Critical Reviews ISSN- 2394-5125 Vol 6, Issue 5, The proposed Algorithm Consist of two phases, the first phase is image transformation, and the second phase is lane detection. Image transformation is done by using the Inverse perspective Mapping (IPM). IPM transforms the image into a bird's eye view. EW-CSA algorithm is used to tune the optimal weights for the DCNN, for the lane detection

O. T. Ekşi and g. Gökmen" **Comparing of Some Convolutional Neural Network (CNN) Architectures for Lane Detection** Here the author had compared some of the Convolutional Neural Network such as LeNet, VGG Net 16, VGG Net 19, Alex Net, Reset Net 50 with various epochs such as 8, 16 and 32 for Lane detection, The experiments showed that CNN architectures played an active role in lane detection regarding their complexity to extract more sophisticated image features. Even though LeNet5 is an outdated architecture, it gave good results for some cases. Deeper architectures such as VGG Net and ResNet could detect the lane more accurately. It was observed that the batch size influenced the detection accuracy, and about 90% IoU score was taken with ResNet50 by the batch size of 32. The batch size also affected the number of epochs, which was limited to 100, utilizing an early stop call-back function in a direct proportion.

M. Prabu, Pooja Patil, Mallika Yadav, Nidhi Ranjan" **Automated Traffic Sign Recognition System using Computer Vision,"** International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-9 Issue-1, November. Here the author has taken the real time images from the camera and the image are segregation or partitioning of video feed into images and it is partitions the image into different sets of pixels called super-pixels. Here each pixels defines some properties which helps in recognizing the signs and the ANN or CNN extracts the features of the input image and matches them with an existing library of traffic sign. The output is fed to the driving assistance system and it in turn.

Danyah A. Alghmghama, Ghazanfar Latif a, b*, Jaafar Alghazo a, Loay Alzubaidi an" **Autonomous Traffic Sign (ATSR) Detection and Recognition using Deep CNN "** Here the author has taken Arabic Traffic sign and pre-processed the images by changing rgb to gray scale image . The author had portioned the datasets into raining, testing and validating datasets. The images are then fed into the Deep CNN Network . In order to achieve the best recognition rates the author had evaluated CNN architecture with varying parameters . Experimental results show that the proposed CNN architecture achieved an accuracy of 100%, thus higher than those achieved in similar previous studies.

Nazmul Hasan et al." **Traffic Sign Recognition System (TSRS): SVM and Convolutional Neural Network**," 4th International Conference on Inventive Communication and Computational Technologies -Here the author has worked on 12 selected sign to traffic sign detection and recognition purpose. In this intention, the author had used Support Vector Machine (SVM) and Convolutional Neural Network (CNN) individually to detect and recognize the traffic signs. And obtained 98.33% accuracy for SVM with 80:20 train and test data ratio. On the other hand, the test result was 96.40% accurate for CNN.

Qaisar Abbas**" Hybrid Fatigue: A Real-time Driver Drowsiness Detection using Hybrid Features and Transfer Learning**," (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 11, No. 1, -Here the author has collected Columbia gaze dataset (CAVE-DB) to detect various gaze directions and head positions in a different environment. The first step is to face and then use 68-different landmarks point to track driver fatigue from the background video frames. After detecting and segmenting the landmarks points from two-mounted cameras on vehicle, the next step is to extract different visual features along with ECG non-visual features. After collecting those hybrid parameters thorough the CNN model at the collection site, this intelligent data is then passed on to automated and operator-assisted applications, which is developed through the DBN model for classification. Hybrid Fatigue achieved 94.50% of accurate detection accuracy by using multi-cams approach with ECG sensors

Rateb Jabbar∗†, Mohammed Shinoy∗ , Mohamed Kharbeche∗ et al." **Driver Drowsiness Detection Model Using Convolutional Neural Networks Techniques for Android Application."** - Here the author had used NTHU Datasets and facial landmark 63 coordinates are extracted from the images and passed it to a CNN-based trained Deep Learning model to detect drowsy driving behaviour.

Priyanka Basavaraj Murdeshwar et al." **Driver Drowsiness Detection using Machine Learning Approach**" International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 06 Issue: 04 | Apr 2019 -This proposed approach has three stages: detecting Face, detecting Eyes, and detecting drowsiness. Image processing is used to recognize the Face of the driver. Then it extracts the image of the eyes of the driver for detection of drowsiness. The HAAR face detection algorithm takes as captured frames of an image, and then the detected Face is considered as output. Next, CHT is used for tracking eyes from the detected Face. Using EAR (Eye Aspect Ratio), the eye state is detected

Miss. Ankita M. Bhoyar1, Prof. S. N. Sawalkar2" **Implementation on Visual Analysis of Eye State Using Image Processing for Driver Fatigue Detection",** International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 06 Issue: 04 | Apr 201 - The driver fatigue detection system calculates drowsiness level from the driver using a combination of webcam, haar cascade classifier, facial landmark detection. EAR Value is used to calculate whether or not a driver is drowsy

- **Methodology**

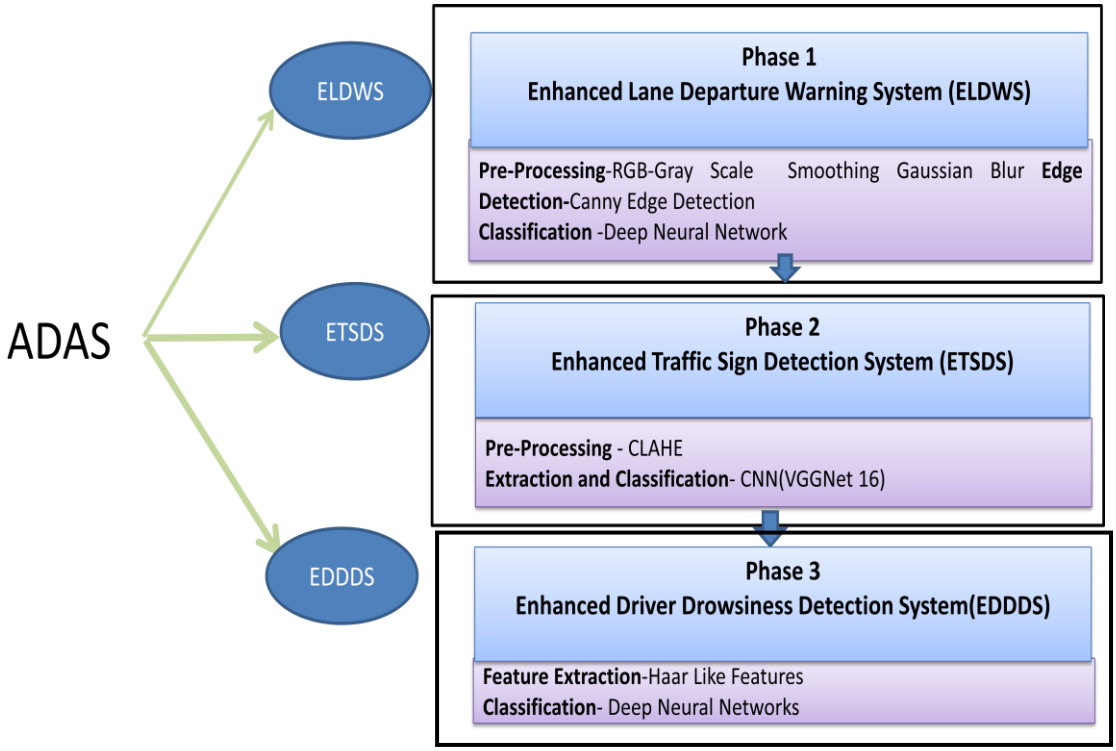

Fig 1:The Overall Methodology

Figs 1 Represents Overall Methodology

In this proposed work, three applications of ADAS is focused namely

1) Lane Departure warning system

2) Identification of traffic sign

3) Drivers drowsiness detection

Phase1:

Lane is defined as the part of a roadway designated for use by a single line of vehicles. Lane is used to giving direction to the driver and also helps in reducing traffic conflicts. Lane detection is an essential aspect of any driver assistance program. A lane departure warning system (LDWS) is a technology developed for warning a driver when any lane departure occurs.

Enhanced Lane Departure Warning System (ELDWS) Here, we use KITTI Datasets for lane detection**.** In the first phase, the input image is acquired, and it is converted to rgb to greyscale and Gaussian Filter to smoothen the image. Then, canny edge detection is applied to detect the edges from the input image. Region of interest (i.e.) Lane marking is obtained here using Trapezoidal Region of Interest and Deep Neural Network is used for extracting the features. Pickle Algorithm is used to visualize the detected lanes. Detected lanes fill green

colour, and Deep Neural Network is used to Detect whether the detected Lane is Lane or Non Lane region. According to the detected Lane, the driver will receive an alert immediately when he crosses it.

Fig 2: Flowchart of Phase 1

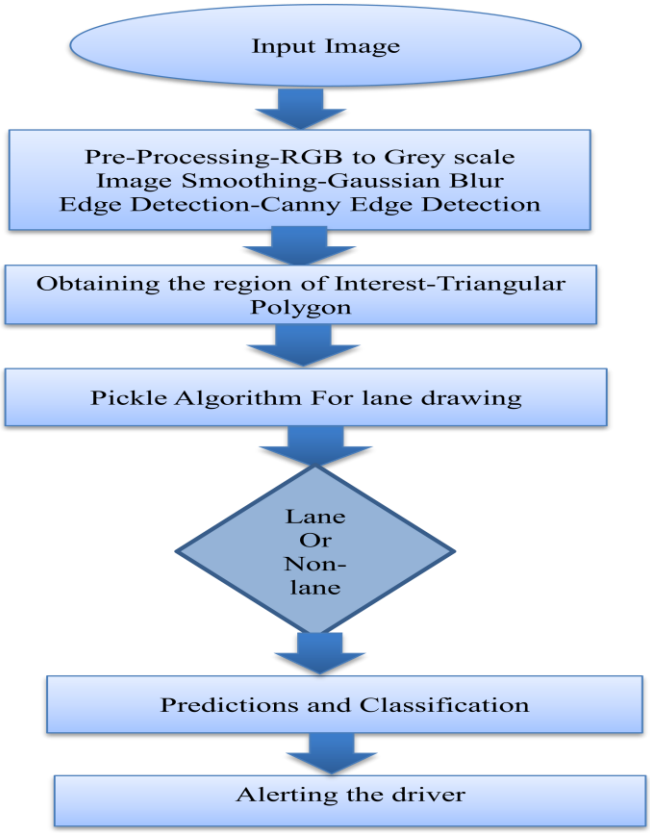

Fig 2 represents the Flow chart of Phase 1

Phase II Enhanced Traffic Sign Detection System (ETSDS);

Traffic sign

Traffic signs occupy an important position in road traffic systems. The primary function of the traffic signs is to display the contents that need to be noticed in the current road sections, to prompt the drivers in front of the road the danger and difficulty in the environment, to warn the driver to drive at the prescribed speed, to provide a favourable guarantee for safe driving**.** However, the challenges faced due to bad weather conditions, illumination, rotation, shifting, occlusion faced by the model increase the complexity range of variation a classifier must undergo. Traffic sign recognition is based on the Advanced Driving Assistance System (ADAS), which vehicles use to recognise various traffic signs ahead. The system takes continuous video input from the dashboard camera, or the camera mounted on the car's bonnet. The underlying algorithm extracts the input image features and matches them with an existing library of traffic signs. The output is fed to the driving assistance system, and it, in turn, drives the car accordingly.

In the second phase, we use German Traffic Sign Benchmark Datasets. First, the input image is acquired, and for pre-processing CLAHE is used as the input image. We used an Enhanced VGG Net 16 for Traffic Sign Detection

Fig 2: Flowchart of Phase 1I

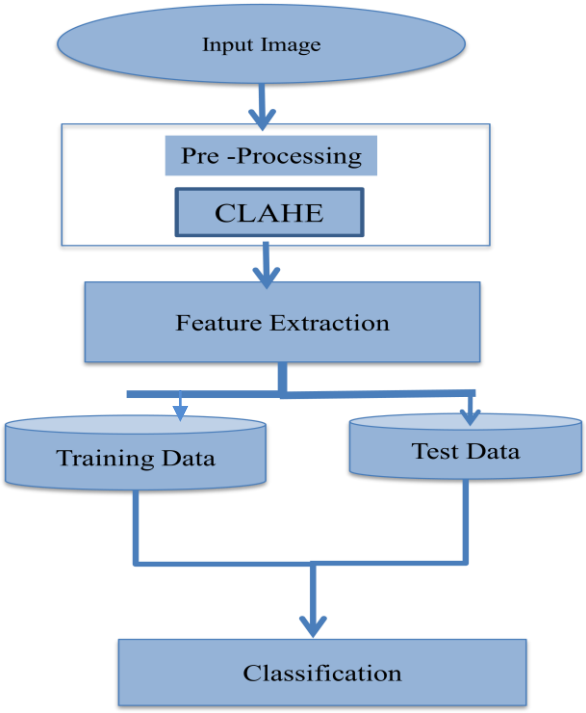

Fig 3 represents the Flow chart of Phase 1I

PHASE III Enhanced Driver Drowsiness Detection System (EDDDS)

Fatigue is referred to as tiredness, restlessness, exhaustion, and lethargy, which describe the physical and abstract state of being tired or weak. Frequent yawning, trouble keeping head up, frequent eye blinking, heavy eyelids, forgetting the things that happened before few minutes, drifting from the lane position, and cardiac abnormalities are common characteristics of drowsiness. Statistics show that nearly 20% of vehicle accidents are because of driver fatigue, and almost 50% of this result in death or severe injuries due to these types of crashes.

In the third phase, from both real and NTHU Datasets, the input image is obtained. Then, Haar Like features are applied to extract the Eye Aspect Ratio value and estimate the head pose for detecting the driver's drowsiness.

Eye Aspect Ratio Formulae

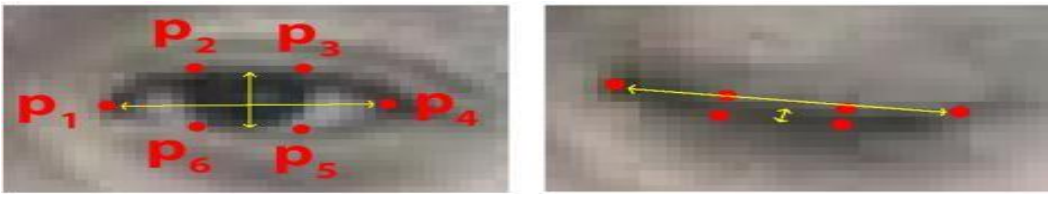

Fig 4: Calculating the Eye Aspect Ratio

$$EAR = \frac{|p_2 - p_6| + |p_3 - p_5|}{2|p_1 - p_4|}.$$

As shown in the figure p1, p2, p3..., p6 has denoted the six facial landmark points of the eye. Therefore, the EAR value is high for open eyes, and the value goes towards zero as the eyes close. So, decreasing EAR values indicate that the eye is gradually approaching, and the value is almost zero for completely closed eyes (when the eye blinks). Here EAR threshold value is set to 0.25. If the EAR threshold value(x) is below 0.25, the eyes are said to be closed the Drowsiness alert is generated to the driver

Estimating the Head Pose

It is the process of determining the three-dimensional orientation and position of the head.

(rotation and translation). The head actions are also utilized as the input.

Three possible head movements are

- **Pitch -** Vertical movement of the head (looking up or down),
- **Roll -** Rotation of the head by tilting the head towards the shoulders,
- **Yaw-** Horizontal movement of head rotation (looking left or right).

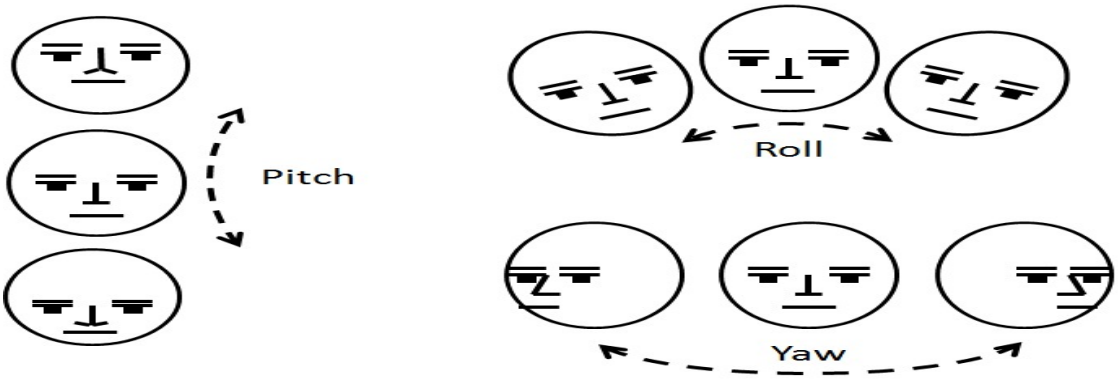

Fig 5: Head Pose of Pitch, Roll, Yaw

We use Enhanced Deep Neural Network for training and testing the datasets and to classify whether the driver is drowsy or not. If the system detects eyes closed, mouth opened and continuously yawning or head tilt, immediately alert the driver by an alarm sound with display message to wake up the drivers

Fig 6 **Flowchart of Phase III**

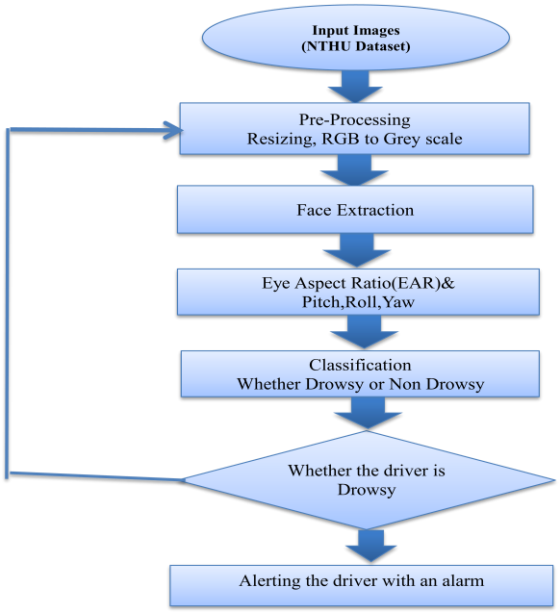

Fig 3 represents the Flow chart of Phase 1II

Experimental Results and Discussion

From the Phase I **ELDWS (Enhanced Lane Departure Warning System),** tabular comparative experiments are done to evaluate the Detection Accuracy and running Time in this subsection

Algorithms	**Detection Accuracy**	**Running Time (ms/frame)**
Vision Based Lane Detection	84%	314.75
Faster RCNN	58.78	122
Context & RCNN	79.26	197
Yolo v3 (S × S)	87.42	24.8
T-S Yolo v3 (S × 2S)	88.39	25.2
ELDW System	**99.89**	**24.5**

From the above Table 1, we can see that the Proposed Algorithm DNN works significantly better than the existing methods for LDWS in terms of Accuracy and Running Time.

From the Phase II Enhanced Traffic Sign Detection System (SDS). The results are compared with VGG16 and IVGG Net and VGG Net with different Layers, and the performance of various algorithms based on accuracy are implemented as follows

Architecture	**Accuracy in %**
VGG16(12 Layers)	99.3
EVGG 16(25 Layers)	**99.75**
ResNet 34	99.6
Committee of CNN	99.4
IVGG Net(9Layers)	99.0

From the Phase III Enhanced Driver Drowsiness Detection System (EDDDS). Comparative results here the Model is implemented with DNN with different Layers and the performance of various algorithms based on accuracy are implemented as follows

Category	**Behavioural**	**Accuracy in %**
CNN	Driver Eyes	83.33
Multi-task ConNN	driver's eye and mouth information	98.8
MTCNN,VGG11,LSTM	eye and mouth regions.	84.85%
VGG-16, LSTM	Face Detection	85.52%
Multi-granularity CNN, LSTM	Face Detection	90.05%
Proposed DDDS with DNN	driver's eyes and Pitch,Roll,Yaw Values	98.9

Conclusion

Enhanced Advanced Driving Assistance system was successfuly implemented with 3 phases namely-

- Phase 1:ELDWS was used to detect lanes in the driving path and warn the driver in-case of out-of-lane condition,
- Phase II: Enhanced TSDS was used to recognize the traffic signs along the road in order to alert the drivers while driving,
- Phase III: Real Time Driver Drowsiness Monitoring System using face recognition technique helps to prevent accidents caused by the drivers getting drowsy.

Scope of Future Work

- The Environmental features such as Rain, Shadows etc and its Real Time implementation can be taken into account for further studies.
- Can include other features of ADAS such as speed bump detection and Pedestrian detection.
- Focus on increasing the size of the dataset and publishing it so that it can be used by other researchers for benchmarking purposed.
- Developing more robust and computationally low cost recognition systems can also be extended

References:

1)Jinju Zang, Wei Zhou,Guanwen Zhang, Zhemin Duan**" Traffic Lane Detection using Fully Convolutional Neural Network",** Proceedings, APSIPA Annual Summit and Conference 2018

2)Riadh Ayachi1 Yahia ElFahem Said1,2* Mohamed Atri1" **To Perform Road Signs Recognition for Autonomous Vehicles Using Cascaded Deep Learning Pipeline**", Artificial Intelligence Advances | Volume 01 | Issue 01 | April 2019.

3) 1)Jinju Zang, Wei Zhou,Guanwen Zhang, Zhemin Duan**" Traffic Lane Detection using Fully Convolutional Neural Network",** Proceedings, APSIPA Annual Summit and Conference 2018 .

4) Zhongyu Wang ,Hui Guo" **Research on Traffic Sign Detection Based on Convolutional Neural Network",** *International Symposium on Visual Information Communication and Interaction - VINCI',2019.*

5) Jun Ho Chung1 · Dong Won Kim2 · Tae Koo Kang3 · Myo Taeg Lim" **Traffic Sign Recognition in Harsh Environment Using Attention Based Convolutional Pooling Neural Network**", Springer, Mar 2020

6) Danyah A. Alghmghama , Ghazanfar Latif a, b*, Jaafar Alghazo a , Loay Alzubaidi" **Autonomous Traffic Sign (ATSR) Detection and Recognition using Deep CNN**",Elseiver,2019

7) Maithili Lakshadeep Dessai1 , Dr. Luis C Mesquita2, Cassandra Fernandes" **TRAFFIC SIGN RECOGNITION USING IMAGE PROCESSING**", International journal of current engineering and scientific research (ijcesR),2018

8)Venkata Rami Reddy Chirra1,3* , Srinivasulu Reddy Uyyala2 , Venkata Krishna Kishore Kolli3" **Deep CNN: A Machine Learning Approach for Driver Drowsiness Detection Based on Eye State",** International Information and Engineering Technology and Association

9) Sukrit Mehta, Sharad Dadhich, Sahil Gumber, Arpita Jadhav Bhatt" **Real-Time Driver Drowsiness Detection System Using Eye Aspect Ratio and Eye Closure Ratio ",** International Conference on Sustainable Computing in Science, Technology, and Management,2019

10) Wanghua Deng1 Ruoxue Wu12" **Real-Time Driver-Drowsiness Detection System Using Facial Features", IEEE Access**

List of Conferences

1) Mirunalini K. and Vasantha Kalyani David , 2018, January . "**Techniques for Detection of Lanes on Roads-A Review"** ,In International Conference on Advance in ComputerScience ,Engineering and Technology, ISSN: 1311-8080 (printed version); ISSN: 1314-3395 (on-line version) Year:2018 Page no:2835-2839

2) Mirunalini K. and Vasantha Kalyani David," **Vehicle and Speed Detection Using Image Processing Techniques ",** International Conference on SMAC-Reshaping the Future , ISSN No: 0975-1718 (Print): Online ISSN No :2249-3247 (Online) Year:January–June, 2018 Vol.10(1): 2018,Pg.No:86-89

3) Mirunalini K. and Vasantha Kalyani David," **Comparative study of various methods adapted in lane detection",** National Conference on Research Trends in Big Data and Intelligent Computing ,Saturday 23rd March 2019

List of Publication

1)K.Mirunalini,Dr .Vasantha Kalyani Daivid" **Vehicle and Speed Detection using Image Processing Techniques**", International Journal of Theoretical & Applied Sciences, Special Issue 10(1): 86-90(2018)

2)K.Mirunalini,Dr .Vasantha Kalyani Daivid" **Techniques for Detection of Lanes on Roads–A Review",** International Journal of Pure and Applied Mathematics Volume 118 No. 18 2018, 2835-2840 ISSN: 1311-8080 (printed version); ISSN: 1314-3395 (on-line version)

3) K.Mirunalini,Dr .Vasantha Kalyani Daivid" **COMPARATIVE STUDY OF VARIOUS METHODS ADAPTED IN LANE DETECTION**", International Journal of Research and Analytical Reviews (IJRAR), Volume 6 Issue 2 , Date of Publication: June 2019 2019-03-27 02:34:24

4) K.Mirunalini,Dr .Vasantha Kalyani Daivid ," **Drowsiness Detection Using Deep Neural Network**" , Turkish Journal of Computer and Mathematics Education (TURCOMAT) Scopus Q4, Vol.12 No.9 (2021), 317-326

5) K. Mirunalini, Vasantha Kalyani David," **Traffic sign Detection using CNN",** International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249-8958, Volume-10 Issue-3, February 2021

6) K. Mirunalini, Vasantha Kalyani David**, "Traffic Sign Detection Using Traffic Convolutional Neural",** International Journal of Grid and Distributed computing, Vol.14, No. 1, (2021), pp. 2967-2976**.**